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Age, Gender and Vitamin D3 as Determinants of Cardiac Risk: A Cross-Sectional Study on Preventive Care

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Abstract **Background:** Cardiovascular disease (CVD) continues to be a major global health challenge, with its risk influenced by both modifiable and non-modifiable factors. Evidence suggests an inverse relationship between serum vitamin D3 levels and cardiovascular risk, influenced by age, gender, and lifestyle. **Aim:** This study aims to assess the prevalence of CVD risk factors and evaluate the role of vitamin D3 status among adult IT professionals in suburban Chennai. **Methods:** A cross-sectional descriptive study was conducted from March to April 2024 among 172 adults working in selected IT companies. Participants were chosen via convenience sampling, and data were collected through self-reported questionnaires and physiological assessments including blood pressure, BMI, and serum 25-hydroxy vitamin D levels. Statistical analyses involved Pearson correlation, one-way ANOVA, and Bonferroni post-hoc tests to determine associations between vitamin D3 and CVD risk factors. **Results:** Among 172 adult participants, 75.6% were had deficient, 23.3% had insufficient and only 1.2 % had normal level of vitamin D3. Overweight and obesity were observed in 47.8% and 18.4% respectively, while 38.6% exhibited elevated blood pressure. CVD risk factors were more prevalent in individuals aged ≥40 years (71.2%) compared to those <40 years (42.5%). Males showed a higher prevalence (65.3%) of risk factors than females (48.7%), with postmenopausal women showing a notable rise (69.4%). A moderate negative correlation was found between systolic blood pressure (SBP) and Vitamin D3 ($R = -0.491$, $p = 0.000$), and a moderate to strong negative correlation between diastolic blood pressure (DBP) and Vitamin D3 ($R = -0.566$, $p = 0.000$). Both correlations were statistically significant at the 1% level. Age significantly affects vitamin D levels ($P = 0.021$), while gender and profession show no significant impact. **Conclusion:** The study underscores the importance of recognizing vitamin D3 deficiency, alongside age, gender, BMI, and blood pressure, as critical contributors to cardiovascular risk. Regular screening and early lifestyle interventions, including vitamin D optimization, may serve as effective strategies in mitigating the growing burden of CVD, especially in high-risk populations such as urban IT workers.

Key Words IT professionals, cardiovascular disease, vitamin D3, BMI

INTRODUCTION

Cardiovascular disease (CVD) is a leading cause of morbidity and mortality worldwide, influenced by a range of risk factors such as hypertension, diabetes, and lifestyle choices. Recent research has focused on the role of vitamin D (specifically vitamin D3) as a modifiable risk factor for CVD. The relationship between vitamin D levels and cardiovascular health is influenced by various determinants, including age and gender, alongside the biological impacts of vitamin D itself.

Multiple studies have demonstrated an inverse relationship between vitamin D levels and the incidence of CVD. A study found that low vitamin D3 levels correlated with an increased risk of acute coronary syndrome and other cardiac disorders, particularly in patients with unstable angina [1,2]. Furthermore, Abdulaali *et al.* highlighted that supplementation with vitamin D3 significantly altered biochemical markers associated with hypertension, suggesting a potential cardioprotective effect in populations at risk [3,4].

The impact of vitamin D on cardiovascular health is also reported to be modulated by age and gender. Manson *et al.* [5] illustrated that older adults might benefit from higher doses of vitamin D in reducing cardiovascular events.

Schnatz *et al.* [6] emphasized the importance of considering gender in research and treatment plans, as vitamin D deficiency is noted to be a risk factor for CVD in postmenopausal women. Similarly, Jasim *et al.* reported that vitamin D deficiency is prevalent among patients with ischemic heart disease, underlining its significance in older and specifically female demographics [7].

Gender differences in vitamin D levels and heart disease also have been observed; the Health Professional Follow-Up Study found that men with lower vitamin D levels had an increased likelihood of heart attacks compared to those with adequate levels [8]. This correlation may extend to metabolic factors, as some studies indicate that vitamin D may influence insulin regulation, which is pertinent to cardiovascular health [9].

The evidence indicates that vitamin D3 deficiency is significant in the context of CVD, as it has potential pathophysiological implications. Durrant *et al.* noted that vitamin D impacts gene expression, which can modulate various biological processes including inflammation and vascular health, thus linking vitamin D status directly to cardiovascular health [10]. Data suggest that adequate levels of vitamin D may help mitigate cardiovascular risks through pathways affecting blood pressure and endothelial function, highlighting the importance of monitoring vitamin D status as part of preventive healthcare strategies [11,12].

Cross-sectional studies indicate that lower vitamin D levels may precede the onset of hypertension and other heart-related conditions, making it a crucial focus for early intervention strategies [13]. Alghamdi *et al.* [14] reinforced these findings by showing that vitamin D3 supplementation could improve metabolic profiles in patients, although the relationship is complex and not universally evident in all populations.

Lifestyle changes have contributed a lot in health-related issues. Indoor sedentary lifestyle has kindled the incidence of CVD. Both CVD and low level of Vitamin D become a victim of the era of global changes in life style of an individual [15].

The interplay of age, gender, and vitamin D3 levels significantly impacts cardiac risk, emphasizing the need for further research and tailored interventions in preventive healthcare aimed at managing cardiovascular diseases. Ensuring adequate vitamin D levels, particularly in identified at-risk populations, could prove beneficial in reducing the burden of CVD. The need for improvement in vitamin status [16] and prevention of CVD risk of the Indian population is both important and urgent.

Aim of the Study

The study aimed to identify the prevalence and impact of CVD risk factors and vitamin D3 among adults.

METHODS

Ethical clearance was obtained by the Institutional Ethics Committee in the present study. (007/11/2023/IEC/SMCH). This study used cross-sectional descriptive design and it was carried out from March 2024 to April 2024. Among twelve companies in suburban western part of Chennai, three Information Technology (IT) companies were selected. 172 adults who gave written consent for data collection including blood investigation and who fulfilled inclusion criteria were selected as study participants through convenient sampling technique.

Data Collection Procedure

Furthermore, written informed consent was secured from all adults before data collection and the study was carried out in accordance with established ethical guidelines. The first section of the questionnaire was related to demographic profile of the adults. The participants self-report their data. Physiological variables such as systolic and diastolic blood pressure, height, weight, BMI were measured along with 25-Hydroxy Vitamin D test. All data were collected as a continuous data and based on mean data were categorized.

Statistical Analysis

All statistical analyses were conducted using SigmaPlot 14.5, a software commonly used for data analysis and visualization. Demographic data were presented as frequencies and percentages. Physiological risk factors were evaluated using Pearson correlation to examine their relationship with Vitamin D3 levels. The dependent variables were expressed as mean, standard deviation (SD), and standard error (SE). For multiple comparisons, one-way ANOVA with Bonferroni post-hoc tests was applied, with a significance level set at $p \leq 0.05$.

RESULTS

Characteristics of Demographic variables

Out of 272 adult participants was 33.9 year and 77.9% were less than 39 years, and 22.09% where above 40 years. And 79.7% were male and 20.3% were female. Majority were married (59.9%) and 54.7% secured professional degree. 86% were working as a professional in an IT company and few (14%) as a semi-skilled worker.

Physiological Risk Factors

The study results revealed that among 172 adult participants, 96% had increased Systolic Blood pressure (SBP), only 4% had normal. And 65% had increased Diastolic Blood Pressure (DBP) and 35 % of adults had normal DBP. Regarding Body Mass Index (BMI), 72.6% had more than normal (>24.9) and only 27.3% had normal BMI (18.5-

Table 1: Physiological variables of adult participants. (N=172)

Parameters	SBP	DBP	Ht	Wt	BMI	V-D
Mean	141.73	88.13	166	74.4	27.1	17.08
Median	140	86.5	167	75.8	26.9	17.0
Standard deviation	15.19	13.09	10.5	14.0	5.36	5.02

Table 2: Physiological Risk Factors of Adults in relation with Age

	Less than 39 Years (N = 134)				40 Years and above (N = 38)			
Parameters	SBP	DBP	BMI	Vit D	SBP	DBP	BMI	Vit D
Mean	141.4	85.6	23.8	17.55	143.2	86.3	38.8	15.43
Standard deviation	12.7	11.4	21.3	5.02	12.7	9.9	21.3	4.72

Table 3: Physiological Risk Factors of Adults in relation with Gender

	Male (N=137)				Female (N=35)			
Parameters	SBP	DBP	BMI	Vit D	SBP	DBP	BMI	Vit D
Mean	142.4	86.2	40.31	17.24	139.17	83.74	39	16.43
Standard deviation	13.5	11.4	22.8	4.8	8.63	9.17	21.4	5.62

Table 4: Correlation between Systolic BP and Vitamin D3

S. No.	Variable	N	Mean	SD	R Value	P value
1	Systolic BP	172	141.73	15.192	-0.491	0.000**
2	Vitamin D3	172	17.08	5.022		

**: Significant at 1% level, *: Significant at 5% level

Table 5: Correlation between Diastolic BP and Vitamin D3

S. No.	Variable	N	Mean	SD	R Value	P value
1	Diastolic BP	172	88.13	13.090	-0.566	0.000**
2	Vitamin D3	172	17.08	5.022		

**: Significant at 1% level, *: Significant at 5% level

Table 6: Analysis of socio-demographic variables as risk factor for vitamin D (N=172)

S.No.	Variable	Category	Mean	SD	SE	Statistics
1	Age (years)	<39	17.55	5.02	0.43	F = 5.399
		>40	15.43	4.72	0.77	P = 0.021
2	Gender	Male	17.24	4.8	0.41	F = 0.730
		Female	16.43	5.62	0.95	P = 0.394
5	Profession	Semi-skilled	16.73	4.98	1.21	F = 0.0047
		Professional	17.21	4.97	0.51	P = 0.946

The 'F' and 'P' values are by one-way ANOVA with Bonferroni 't' test for multiple comparisons

24.9). Considering their vitamin D3 level, 75.6% were had deficient, 23.3% had insufficient and only 1.2 % had normal level of vitamin D3. The mean (SD) value of systolic and diastolic blood pressure, BMI and Vitamin D3 was, 141.73 (±15.19) mmHg, 88.13 (±13.09) mm Hg, 27.1 (±5.36) and 17.08 (±5.02) ng/dL respectively (Table 1).

In Table 2, physiological risk factors are compared across age groups. Individuals under 39 years (N=134) had a mean systolic blood pressure (SBP) of 141.4 mmHg and diastolic blood pressure (DBP) of 85.6 mmHg, while those 40 years and older (N=38) had slightly higher values (SBP 143.2 mmHg, DBP 86.3 mmHg). The younger group had a lower BMI (23.8) compared to the older group (38.8), and Vitamin D levels were slightly higher in the younger group (17.55 ng/mL) compared to the older group (15.43 ng/mL). Standard deviations for these measures were similar across both groups.

In Table 3, physiological risk factors are compared between genders. Males (N=137) had a higher mean SBP (142.4 mmHg) and DBP (86.2 mmHg) than females (139.17 mmHg and 83.74 mmHg, respectively). Males also had a higher BMI (40.31) compared to females (39.0). Vitamin D levels were slightly higher in males (17.24 ng/mL) than in females (16.43 ng/mL), with females showing greater variation in Vitamin D levels (standard deviation of 5.62 ng/mL versus 4.8 ng/mL in males).

Table 4 shows a moderate negative correlation between systolic blood pressure (SBP) and Vitamin D3 (R = -0.491, p = 0.000), with mean SBP of 141.73 mmHg and mean Vitamin D3 level of 17.08 ng/mL. Table 5 reveals a moderate to strong negative correlation between diastolic blood pressure (DBP) and Vitamin D3 (R = -0.566, p = 0.000), with mean DBP of 88.13 mmHg and the same Vitamin D3 level of 17.08 ng/mL. Both correlations are statistically significant at the 1% level. The analysis shows that age is a significant factor for vitamin D levels, with those under 39 having higher levels (mean = 17.55) compared to those over 40 (mean = 15.43, P = 0.021).

Gender and profession do not significantly affect vitamin D levels (P = 0.394 and P = 0.946, respectively) (Table 6).

As shown in Figure 1, the majority of participants demonstrated elevated systolic blood pressure values, and deficient Vitamin D3 levels. A significant negative correlation was observed between Vitamin D3 levels and both systolic and diastolic blood pressure, as illustrated in Figure 2.

DISCUSSION

The findings from the study of 172 adults reveal critical insights into the state of cardiovascular health and potential associations with serum Vitamin D3 levels. A significant 96% of participants exhibited elevated systolic blood pressure (SBP), while 65% showed increased diastolic blood pressure (DBP), alongside a considerable burden of

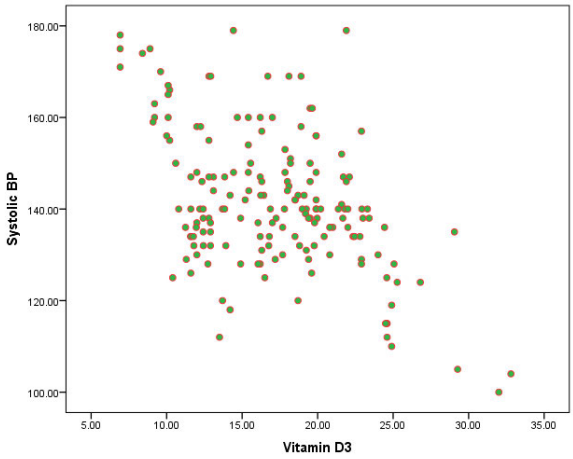

Figure 1: Distribution of physiological risk factors (systolic blood pressure and Vitamin D3 levels) among adult IT professionals in suburban Chennai

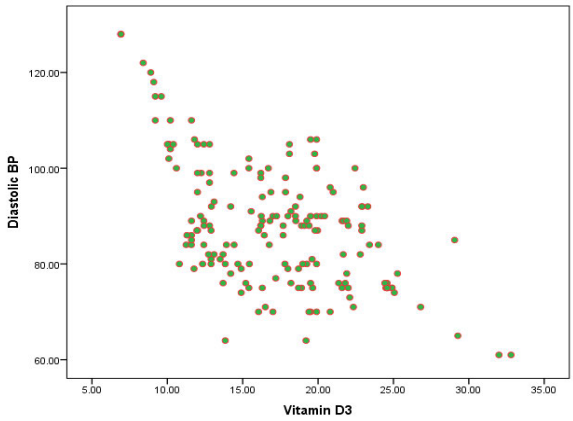

Figure 2: Correlation between Vitamin D3 levels and blood pressure parameters (DBP) in the study population

overweight or obesity, indicated by a body mass index (BMI) above the normal range in 72.6% of individuals. The mean SBP recorded was 141.73 mmHg, and DBP was 88.13 mmHg, highlighting a concerning prevalence of hypertension within this group. Elevated blood pressure is well-documented as a predictor of mortality and morbidity in various populations [17,18]. The relationships between blood pressure and BMI have also been substantiated in existing literature, which notes that higher BMI tends to correlate with increased SBP and DBP [19,20].

Additionally, the study indicates a significant presence of Vitamin D3 deficiency among the population, affecting 75.6% of participants, with a mean level of 17.08 ng/mL, which is below recommended thresholds. The correlation between low Vitamin D levels and hypertension has been documented in numerous studies, establishing that lower serum Vitamin D is associated with higher blood pressure measurements [21,22]. Such findings suggest that Vitamin D status may play a role in the modulation of blood pressure, reinforcing the need for future research to clarify these mechanisms further.

Age-related differences observed in the study highlight an interesting trend: participants under 39 experienced lower averages of both SBP and DBP alongside higher Vitamin D3 levels. This aligns with previous findings indicating that younger cohorts often exhibit more favorable cardiovascular profiles [23]

The significant negative correlations identified (R = -0.491 for SBP and R = -0.566 for DBP) with Vitamin D3 levels not only highlight a potential physiological relationship but also underscore the importance of addressing Vitamin D deficiency in hypertensive individuals [24]. Addressing these deficiencies could be a pivotal strategy in hypertension management.

The study reinforces the relationships between elevated blood pressure, obesity, and Vitamin D3 deficiency in a significant segment of the adult population. The evidence suggests that addressing modifiable risk factors such as BMI and Vitamin D levels is essential in combating hypertension, thus reducing the overall risk of cardiovascular diseases.

CONCLUSIONS

The study highlighted a high prevalence of elevated blood pressure and BMI, alongside widespread Vitamin D3 deficiency. It also highlighted a negative correlation between blood pressure and Vitamin D3, suggesting a potential link to cardiovascular risk. Additionally, age and gender differences were noted, emphasizing the need for targeted interventions. The findings highlight the importance of addressing Vitamin D3 deficiency in managing cardiovascular health.

Limitations

The study's limitations include a small sample size, which may limit the generalizability of the findings. The cross-sectional design prevents establishing causality between Vitamin D3 levels and cardiovascular risk factors. Additionally, potential confounding factors such as diet, physical activity, and sunlight exposure were not controlled for. The study also relied on self-reported data for certain variables, which may introduce bias. Future research with larger, more diverse samples and longitudinal designs is needed to confirm these findings and address these limitations.

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